



# An important new record of Military Macaw, *Ara militaris* (Linnaeus, 1766) (Psittacidae), in Santo Domingo Narro, Oaxaca, Mexico

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## Abstract

Military Macaw, *Ara militaris* (Linnaeus, 1766), is in danger of extinction in Mexico and Vulnerable internationally. We recorded a new locality with a notable presence of this species and identified its nocturnal resting site by the Tehuantepec River, near the community of Santo Domingo Narro in the state of Oaxaca, Mexico. We discuss the importance of considering this population as different from those previously identified in Oaxaca state and discuss the threats to this species' conservation and implications for its survival at Santo Domingo Narro and in the region.

## Keywords

Conservation, Mitla–Tehuantepec highway, roosting site, Tehuantepec River

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## Introduction

The distribution of the Military Macaw, *Ara militaris* (Linnaeus, 1766), in the Americas is discontinuous. It occurs in Mexico, Peru, Ecuador, Venezuela, Colombia, Bolivia, and northern Argentina (Iñigo-Eliás 1999). Within each of these seven countries, the species has a patchy, discontinuous distribution that roughly coincides with that of tropical dry and wet forests (Collar 1997). Both the global population size and geographic range of the Military Macaw are shrinking (Collar 1997; Bird-life International 2013). In Mexico, where their distribution is also discontinuous, this species is found on the Pacific slope from southern Sonora and south-eastern

Chihuahua south to Chiapas and on the Gulf of Mexico slope from eastern Nuevo Leon to Queretaro, with roosting populations of 20 to 78 macaws (Arizmendi and Marquez 2000; Monterrubio-Rico et al. 2005; Rivera-Ortiz et al. 2013). The Military Macaw has been eradicated from many localities and entire regions within its original geographic range (Marin-Togo 2012). Population reduction has mainly resulted from the loss and fragmentation of its habitat and trafficking for illegal trade. In Mexico the annual deforestation rate of Military Macaw habitat is 3.27–5.21% (Iñigo-Eliás 1999). Over the course of almost 30 years, 29–32% of the Military Macaw's geographic

range in Mexico has been deforested and local extinction has occurred along the Pacific Slope (Rivera-Ortiz et al. 2017). In Mexico this species is associated with deciduous tropical forest, sub-deciduous tropical forest, and hillside coniferous forest, mainly in mountainous terrain with canyons, although it also occurs on lowlands at sea-level. Thus, the altitudinal range has been documented as 0–2500 m above sea level (Bonilla-Ruz et al. 2007; 2014).

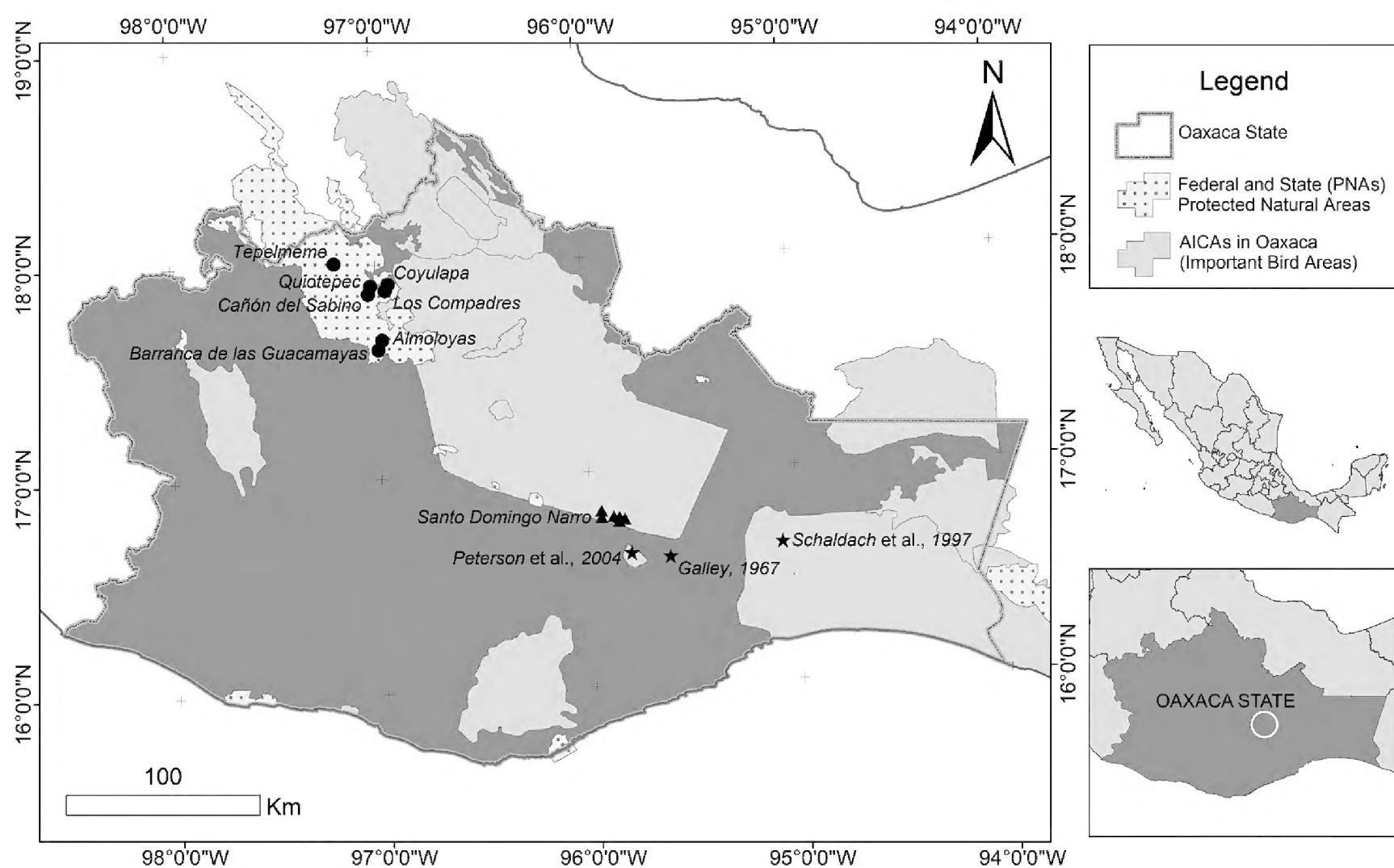
The Military Macaw is one of the 22 species of Psittaciformes that inhabit Mexico (PREP 2000). It is considered a priority species in this country for conservation and is a “Species at Extinction Risk category” in the *Norma Oficial Mexicana* (NOM 059-SEMAR-NAT-2010). Internationally it has been assessed as Vulnerable by the IUCN (2013), and it is in the CITES Appendix I (2013). The Military Macaw is a species of conservation concern in Mexico, with a current estimated population size of fewer than 10,000 individuals and clearly showing a declining trend (BirdLife International 2020).

New locations of the Military Macaw in Mexico started being reported in 2000 and as of 2016, populations have been sighted at resting and reproduction sites La Sierrita (Sonora); Nuestra Señora del Mineral (Sinaloa); El Mirador del Águila and Las Pilas (Nayarit); El Tuito, El Refugio, and Bahía Balderas (Jalisco); Papalutla and Xixila (Guerrero); Santa María de Cocos and Sótano el Barro (Queretaro); Atarjea (Guanajuato); El Cielo (Tamaulipas); and Cañada Los Cocos, Achichipilco (Puebla) (Gaucin 2000; Hernández-Castan et al. 2012; Jimenez-Arcos et al. 2012; Rivera-Ortiz et al. 2013; Ramirez-Albores 2016; Rivera-Ortiz et al. 2016).

In the state of Oaxaca, the Military Macaw had been considered extirpated (Monterrubio-Rico et al. 2005). Salazar (2001) recorded a nesting site with a population of approximately 40 pairs in the canyons of the Sabino and Seco rivers, within the Tehuacán-Cuicatlán Biosphere Reserve, which spans the states of Puebla and Oaxaca. Since then, this population has been extensively studied (Bonilla-Ruz et al. 2007). As it was once thought to be the only reproductive population of Military Macaw in Oaxaca, it has been the subject of long-term monitoring (Arizmendi 2008). However, there are other, uncorroborated records of Military Macaws in Oaxaca. For example, Peterson et al. (2004) recorded a Military Macaw in their biological inventory and possible reproductive activity on the Cerro Piedra Larga, a mountain west of the Isthmus of Tehuantepec.

There are older records of this species in southeastern Oaxaca, including for example eight records from 1960 (Schaldach et al. 1997). For each of these records, one to seven macaws were observed. Schaldach et al. (1997) did not provide the exact coordinates of these sightings but mentioned that they were close to Masahuito, 18 miles (~29 km) south of Matías Romero, 6 miles (~10 km) from Chivela, and 7.4 miles (11.9 km) from Ventosa. Additionally, there is a preserved specimen, collected by Galley in Tequisitlán in 1967, in the Western Foundation of Vertebrate Zoology (WFVZ) Bird Collection, Camarillo, CA, USA (Fig. 1).

In recent years, the conservation of the Military Macaw has become increasingly important, but no recent new records of this species in Tehuantepec region have been published. Currently, studies on biology and ecology of this species are underway in some states of



**Figure 1.** Records of the Military Macaw (*A. militaris*). Triangles are records reported in this study, circles are the sites where the population that lives in the Sabino Canyon has been recorded, and stars represent other records in the state of Oaxaca. Map by Irving Castañeda Guerrero.



Mexico, including Durango, Jalisco, Michoacán, and Oaxaca. However, more information on its distribution is needed to implement conservation actions and management plans, for both the species and the areas in which it occurs (Ornelas et al. 2013).

Our newly reported locality for a Military Macaw population appears to be distinct from the one reported 175 km away in the Sabino Canyon in the Tehuacán-Cuicatlán Biosphere Reserve, given that elsewhere movements to other foraging and resting sites do not usually exceed 21 km from the main population. Would therefore seem to indicate a new location for the green military macaw, in the state of Oaxaca, conforming to observations concerning its behavior, biotic habitats and biogeographic locations. This creates the need of promote more detailed research, long-term protection, and greater conservation efforts for this endangered species.

## Methods

A Military Macaw population in the area of the Tehuantepec River near the community of Santo Domingo Narro in the southern mountain range of the state of Oaxaca, and the identification of a resting site were documented in this study. This area is part of the Sierra Madre del Sur, where landscapes are characterized by mountains and rolling hills with a transitional vegetation gradient resulting from climatic variations, which range from mild to semi-warm to semi-arid. The resulting vegetation is composed of tropical and temperate forests, dominated by lowland deciduous forest, with also pine and/or oak forests and induced grasslands, as well as riparian vegetation along tributaries of the Tehuantepec River and occasional patches in moist ravines on the hillsides (MIA-R Autopista Mitla-Tehuantepec 2014). The study area is within the AICA C17 known as Sierra de Miahuatlán, consisting of 248,000 ha with Ejidal (community) tenure and under threat from agricultural activities, deforestation, and livestock grazing. The Sierra de Miahuatlán is important because it harbors globally threatened species and is isolated from the Sierra Madre del Sur (AICAS- CONABIO 2022).

Our monitoring area includes the area of influence of the Mitla–Tehuantepec highway project. The area of influence, which has an area of 40,746,886 ha, is defined as the area that will be directly and indirectly affected by the construction of the highway. This area was delimited using a geographic information system and based on mainly hydrological criteria (micro-basins, sediment drag in water currents), according to the extent that the noise generated by highway construction would travel, and the visual impact on the area (MIA-R Autopista Mitla-Tehuantepec 2014).

We made our first observation of Military Macaw on 20 January 2012 while monitoring the passage of local fauna on the Mitla–Tehuantepec highway (2012–2013). After this, we attained 27 sightings, while systematically gathering records for five months in 2013 (May, June,

July, November, and December) by undertaking exploratory treks along the Tehuantepec River (Rangel-Salazar and Diez de Bonilla 2010). In addition to direct observations of the Military Macaw, we obtained information from the inhabitants of the Santo Domingo Narro community by conducting non-structured interviews about the sites where they had seen this macaw, or where they considered important to this species. These interviews were conducted with 10 older members of the community who had lived there for more than 30 years. During field excursions to identify resting sites and to obtain the direct observations, photographs were taken, and a feather was also collected to corroborate identification. Whenever possible, we recorded the number of individuals, location, date, and time of the observation. We recorded the geographic coordinates using a Trimble Juno hand-held GPS receiver. This work was based on the manual for the recognition, evaluation, and monitoring of biological diversity, as this formed part of a more general monitoring project (León- Cortes et al. 2010).

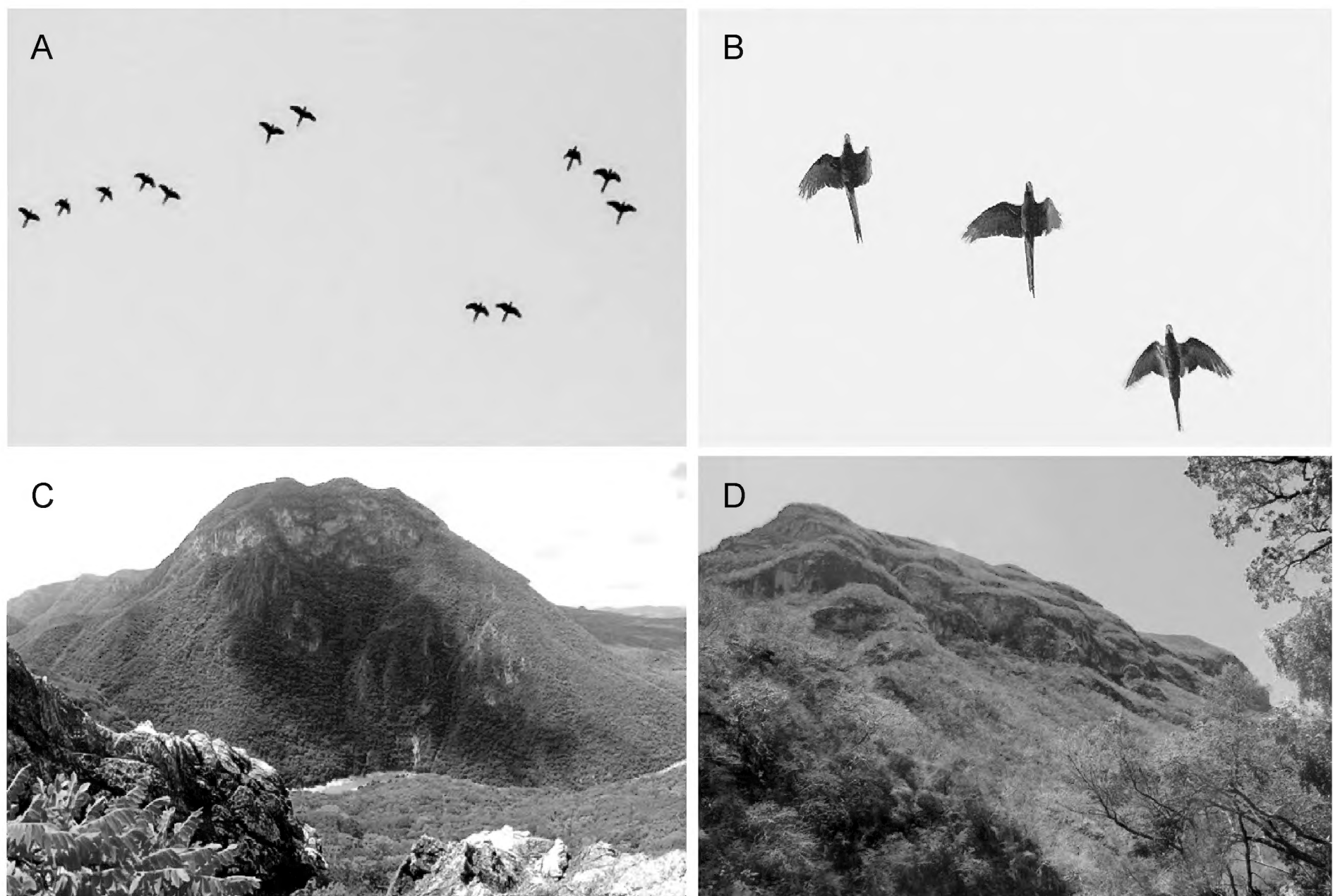
## Results

**New records.** MEXICO – Oaxaca • Tehuantepec River, San Juan Juquila Mixes, Santo Domingo Narro; 16°48.992'N, 095°56.534'W – 16°46.055'N, 095°48.879'W; 443–1171 m elev., 20.I.2012–01.XII.2013; Olguin-Hernández L., Pozo-Montuy G., Villanueva Meza R., Ibarra B., Téllez Torres JG. obs.

**Identification.** We identified the species morphologically from our photographs and direct sightings (Fig. 2). It is clear that this species is *Ara militaris* because it is the only psittacine in Mexico with these characteristics. Its olive to bright green body and matte tone on the back of its neck and crown make it stand out. This mainly green macaw has the flight feathers blue on the top and olive-yellow on the underside. The back is pale blue, the tail is blue and red, and the forehead is crimson red. There is a white facial area with two black lines lacking feathers, and the beak is black (IUCN 2016; Collar et al. 2020). With a length of approximately 70 cm (Van Perlo 2006), *A. militaris* is the second largest bird in Mexico after the Red Macaw, *Ara macao* (Linnaeus, 1758).

Three subspecies are generally recognized for *A. militaris*—*A. m. militaris* (Linnaeus, 1766); *A. m. mexicanus* Ridgway, 1915 and *A. m. bolivianus* Reichenow, 1908 (Forshaw 1989; Clements et al. 2014; Collar et al. 2020)—but the distinctions between subspecies are not well documented (Juniper and Parr 2010; Collar et al. 2020). For example, some researchers recognized two Mexican clades as evolutionarily significant units but given the limited morphological variation within the species, they refrained from making suggestions regarding the nomenclature of subspecies (Eberhard et al. 2015; Rivera-Ortiz et al. 2017). Therefore, we do not attribute the population reported here to a subspecies.

**Remarks.** We recorded 27 observations of between two



**Figure 2.** **A, B.** Military Macaws (*Ara militaris*) in flight. **C, D.** Coyul Hill, nocturnal resting site of this species. Photo credits: Ricardo Torres Flores (A, B); Gilberto Pozo-Montuy (C, D).

and 38 adult Military Macaws, with a mean of  $9.6 \pm 13.2$  macaws/sighting (Table 1). The records obtained include vocalizations and sightings of perched or in-flight macaws, but we also found a feather and located a nocturnal resting site at Cerro Coyul (Fig. 2). The time of arrival and departure, flight direction, as well as the behavior and observations of perched macaws in the evening on the slopes of Cerro Coyul, indicate that this is a roosting area. It is likely that Cerro Coyul is also used as a nesting site, and while we were not able to confirm this, local people mentioned having seen chicks. Our interviews provided local perceptions on the presence of this population over a 50-year period. Finally, concerning the sites where they most frequently observe the species, all people confirmed that Cerro Cuyul has always been the most important site, because it is where the birds sleep and nest, then subsequently flying over the community towards the mountains and the northeast towards San Juan Juquila, Mixes, and San Juan Lachixila, about 15 km from Santo Domingo Narro, where they feed (Fig. 3).

## Discussion

Our observations of Military Macaw at Santo Domingo Narro are approximately 175 km from the known breeding population in the Sabino Canyon and 20 km from the spot it was sighted at Cerro Piedra Larga. Studies carried out in 2001–2006 in the Sabino Canyon established that

the largest home ranges occur in the fall and cover 12,309 ha (Bonilla-Ruz et al. 2007). This allows us to infer that the Santo Domingo Narro birds belong to a different population than those in the Sabino Canyon. However, the Santo Domingo Narro population is likely to be same one observed by Peterson et al. (2004), as movement of up to 21 km between foraging and resting sites have been recorded in populations (Ramírez-Albores 2016). However, we obtained a greater number of records, as well as the location of the roosting site and a possible breeding site, from interviews with local people. This indicates the need for continuing study of this population, as well as research into population genetics in the future (Rivera-Ortiz et al. 2017). In addition to carrying out a program of continuous monitoring of this population, acoustic and behavioral records are important to understand the natural history of Military Macaw at this locality.

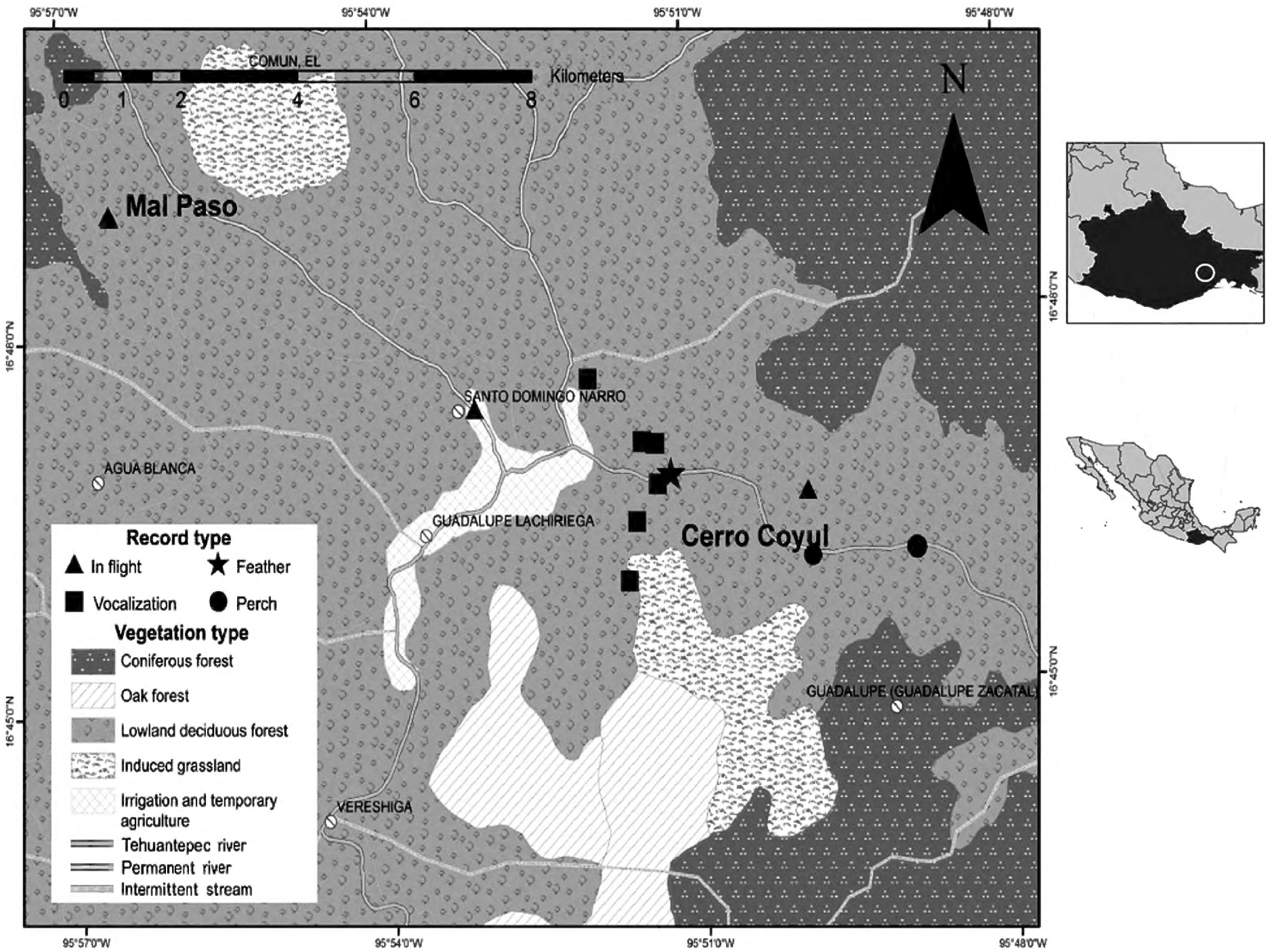
According to the local people, macaws have been observed in the community of Santo Domingo Narro for the past 50 years, concurring with old records in the region reported by Schaldach in 1960 (Schaldach et al. 1997) and Galler in 1967 (WFVZ Bird Collections 1967). However, since then, there has been no further indication of the existence of resting and foraging sites. The inhabitants also mentioned, the highest number of Military Macaws can be observed from January to March, flying over their community and moving along various routes, depending on food availability, to nearby temperate forests.



**Table 1.** Military Macaw (*A. militaris*) record locations in Oaxaca, Mexico, date of observation, type of record, number of macaws observed, and flight direction.

Location	Latitude	Longitude	Date (d/m/y)	Time	Record type*	# individuals	Flight direction
Tehuantepec River banks	16°46.556'N	095°49.907'W	20/01/2012	1115 h	FI	2	E to W
Santo Domingo Narro	16°47.323'N	095°53.089'W	22/01/2012	1756 h	FI	38	NW to SE
Santo Domingo Narro	16°47.323'N	095°53.089'W	23/01/2012	0650 h	FI	38	SE to NW
Tehuantepec River banks	16°46.656'N	095°51.353'W	29/05/2013	1627 h	Pe	—	—
Tehuantepec River banks	16°46.734'N	095°51.220'W	29/05/2013	1600 h	Vo	?	—
Mal Paso	16°47.250'N	095°56.548'W	31/05/2013	0745 h	FI	2	SE to NW
Mal Paso	16°48.992'N	095°56.534'W	31/05/2013	0755 h	FI	3	SE to NW
Mal Paso	16°48.992'N	095°56.534'W	31/05/2013	1035 h	FI	3	NW to SE
Juquila River	16°48.019'N	095°52.298'W	03/06/2013	1230 h	FI	?	—
Coyul Hill	16°46.999'N	095°51.489'W	05/06/2013	0711 h	FI	15	N to S
Coyul Hill	16°46.999'N	095°51.489'W	05/06/2013	0735 h	Vo	?	—
Coyul Hill	16°46.999'N	095°51.489'W	05/06/2013	0741 h	Vo	?	—
Coyul Hill	16°46.982'N	095°51.365'W	05/06/2013	1005 h	Vo	?	—
Coyul Hill	16°46.982'N	095°51.365'W	05/06/2013	1021 h	Vo	?	—
Coyul Hill	16°46.982'N	095°51.365'W	05/06/2013	1220 h	Vo	?	—
Coyul Hill	16°46.982'N	095°51.365'W	05/06/2013	1030 h	Fe	2	E to W
Coyul Hill	16°45.891'N	095°51.657'W	02/07/2013	1252 h	Vo	?	—
Coyul Hill	16°46.363'N	095°51.561'W	02/07/2013	1716 h	Vo	?	—
Tehuantepec River banks	16°46.055'N	095°48.879'W	03/07/2013	0734 h	Pe	2	—
Coyul Hill	16°45.949'N	095°51.458'W	25/07/2013	1908 h	Vo	?	—
Coyul Hill	16°45.949'N	095°51.458'W	25/07/2013	1923 h	Vo	?	—
Tehuantepec River banks	16°46.055'N	095°48.879'W	26/07/2013	0720 h	Pe	3	—
Coyul Hill	16°45.949'N	095°51.458'W	26/07/2013	0715 h	Vo	?	—
Coyul Hill	16°45.949'N	095°51.458'W	26/07/2013	0800 h	Vo	?	—
Coyul Hill Slopes	16°46.824'N	095°51.178'W	30/11/2013	1851 h	Pe	3	—
Coyul Hill	16°45.949'N	095°51.458'W	01/12/2013	1048 h	FI	11	SW to NE
Coyul Hill	16°45.894'N	095°51.569'W	01/12/2013	1027 h	FI	3	SW to NE

\*Abbreviations: FI = flight, Fe = feather, Vo = vocalization, Pe = perch, ? = unknown number of individuals.



**Figure 3.** Sites where the Military Macaw (*A. militaris*) was recorded. Map by Licet Olguin Hernández and corrected by Irving Castañeda Guerrero.

Our new record is important because it documents a new locality for the Military Macaw, and if reproductive activity can be confirmed, this would be the second breeding population in Oaxaca: the first located in Sabino Canyon in northwestern Oaxaca and the second at Santo Domingo Narro in southeastern Oaxaca. Hence, the implementation of conservation actions at the site and short- and long-term studies of the population are needed. Regional threats to this species include poaching, agriculture, farming, and changes in land use, such as the construction of the Mitla-Tehuantepec highway and the growth of rural human populations. The Santo Domingo Narro site is outside the system of protected natural areas, and it is located near where the Mesoamerican Biological Corridor of the Isthmus of Tehuantepec and the Coastal Zone of Oaxaca and Guerrero intersect (CONABIO 2015).

Unfortunately, this population is currently at serious risk due to the construction and operation of the Mitla-Tehuantepec highway, which passes within 750 m of the Military Macaw population at Cerro Coyul. The highway project has seriously changed land use and brought about earth movements, a loss of over 9,000 ha of vegetation, and affected 99 intermittent water courses and 13 permanent ones. About half of the fauna corridors will be affected (MIA-R Autopista Mitla-Tehuantepec 2014). Without doubt, Military Macaw is at serious risk at this locality, and it is urgent that conservation programs be activated.

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## Authors' Contributions

Conceptualization: GPM. Funding acquisition: JGTT. Investigation: LOH. Project administration: JGTT, GPM. Resources: JGTT. Writing – original draft: LOH. Writing – review and editing: GPM.

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